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STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING



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DIRECTOR

January 18, 2002

TO: Janice Tompkins, Grand Rapids District Office
Surface Water Quality Division

FROM: Dave Fongers, Hydrologic Studies Unit
Land and Water Management Division

SUBJECT: Hydrologic Analysis of Hager Creek Reference Reaches

As requested, the Hydrologic Studies Unit of the Land and Water Management Division (LWMD) has completed its hydrological analysis of two reference reaches in the vicinity of Hager Creek. This analysis is in support of a Clean Michigan Initiative (CMI) project to rehabilitate Hager Creek in Ottawa County. Nothing in this memo is an authorization to do any work within the watershed that would require a permit or guarantees that work proposed based on this report will be permitted or funded.

One method for rehabilitating an unstable stream is to design a stable channel based on the morphologic characteristics of stable channels in similar watersheds. To this end, the consultant has suggested two reference reaches. Both reaches are located slightly north of Hager Creek. In this memo, we refer to the watersheds for the unnamed reference reaches as Fillmore and Bauer, as shown in Figure A, based on adjacent road names. Our analysis includes a comparison of the physical characteristics of the watersheds and calculation of surface runoff volumes and peak flows using the runoff curve number technique, developed by the Soil Conservation Service (SCS) in 1954.

The land uses for the three watersheds are shown in Figure B. The area within the Fillmore watershed that appears white is defined as a sand dune. Based on a 1991 aerial photo, this area appears to be excavated. We regard this area as a non-contributing area and did not include it in the surface runoff calculations. Based on land use, the Hager Creek watershed is more similar to the Bauer watershed. The Fillmore watershed has noticeably more residential development and less forest, at least in 1978, than the other two watersheds.

The soil types and hydrogroup classifications are shown in Figures C and D, respectively. Where a soil's hydrogroup was specified by the SCS as A/D, B/D, etc., we have selected the D hydrogroup where the land use is forest or meadow and the alternate hydrogroup where the land use is residential or cropland. Based on hydrogroups, all three watersheds are quite similar. However, the downstream portions of the stream channels are in Sloan soil in the Bauer and Fillmore watersheds, but in Kibbie soil in the Hager Creek watershed. We have not evaluated the effect of this difference on stable channel morphology.

Because the channel forming flow is the design flow of interest, we calculated runoff volumes and peak flows from the 1- and 2-year 24-hour storms, assuming antecedent moisture condition II. Design rainfall values for these events are tabulated in *Rainfall Frequency Atlas of the Midwest*, Bulletin 71, Midwestern Climate Center, 1992, pp. 126-129, and summarized for this site in Table 1.

Table 1: Precipitation Values used in Runoff Calculations

Rainfall Duration	Rainfall (inches) for given recurrence interval	
	1-year	2-year
24-hour	1.95	2.37
12-hour	1.70	2.06
6-hour	1.46	1.78
3-hour	1.25	1.52
2-hour	1.13	1.37
1-hour	0.92	1.11
15-minute	0.53	0.64
5-minute	0.23	0.28

Calculated runoff volumes and peak flows also depend on the drainage area and the time of concentration, which is the time it takes for water to travel from the hydraulically most distant point in the watershed to the design point. The time of concentration is calculated based on the type of flow, slope, and length. The calculated areas and times of concentration are listed in Table 2.

Table 2 - Calculated Areas and Times of Concentration

Drainage Area	Area (acres)	Time of Concentration (hours)	Curve Number
Fillmore	149	0.67	74
Bauer	293	0.73	78
Hager	370	1.60	79

The expected peak discharges and runoff volumes for each watershed were calculated with the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) and are shown in Figures E and F. If you have any questions regarding our evaluation, please contact me at 517-373-0210.

cc: Claire Schwartz, FTCH
Ralph Reznick, SWQD
Ric Sorrell, LWMD
Barry Horney, LWMD

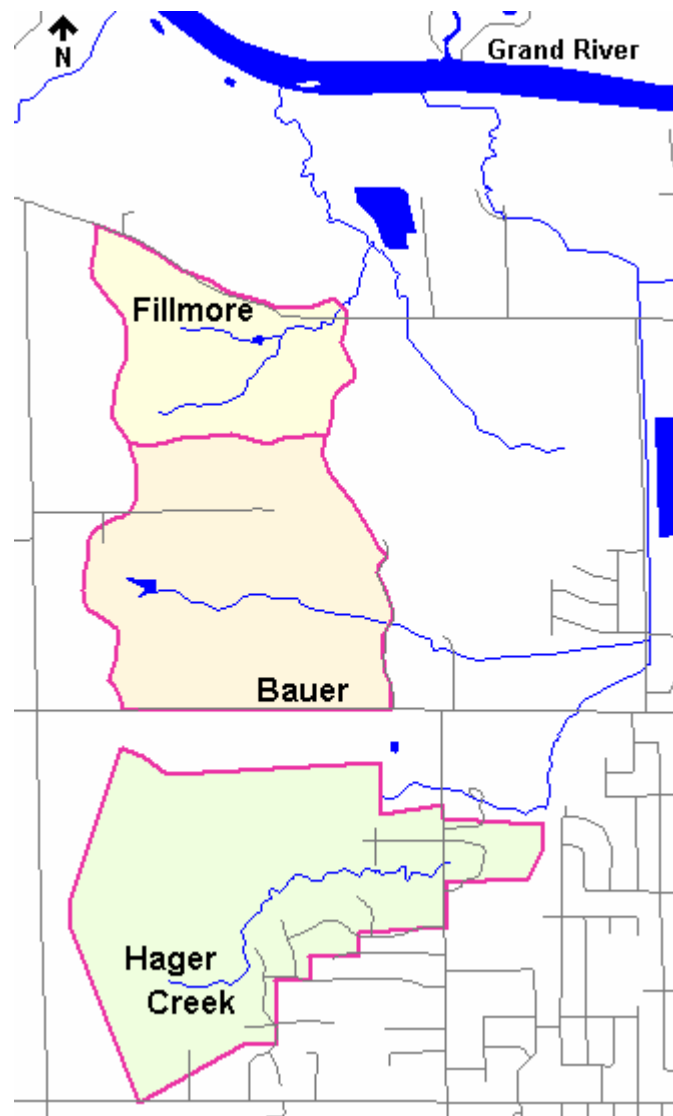


Figure A: Location of reference reach watersheds

Fillmore
Residential: 13.3%
Cropland: 30.0%
Meadow: 13.8%
Forest: 42.9%
Wetland: 0.0%

Bauer
Residential: 2.6%
Cropland: 61.1%
Meadow: 2.3%
Forest: 33.5%
Wetland: 0.5%

Hager
Residential: 0.0%
Cropland: 72.3%
Meadow: 0.8%
Forest: 26.9%
Wetland: 0.0%

1978 Land Use

Residential
Cropland
Meadow
Forest
Wetland
Water

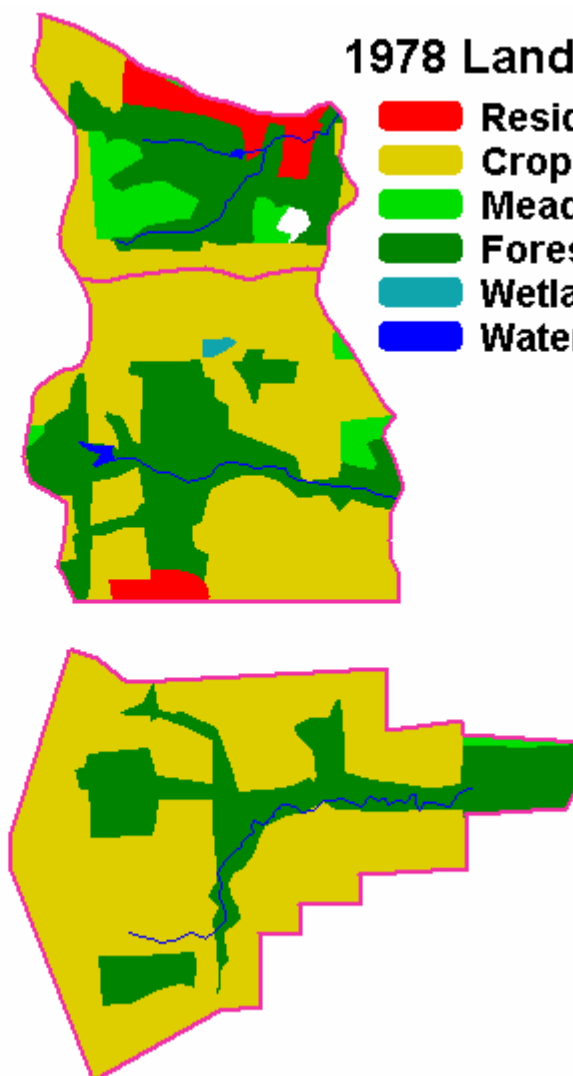


Figure B: 1978 Land Use

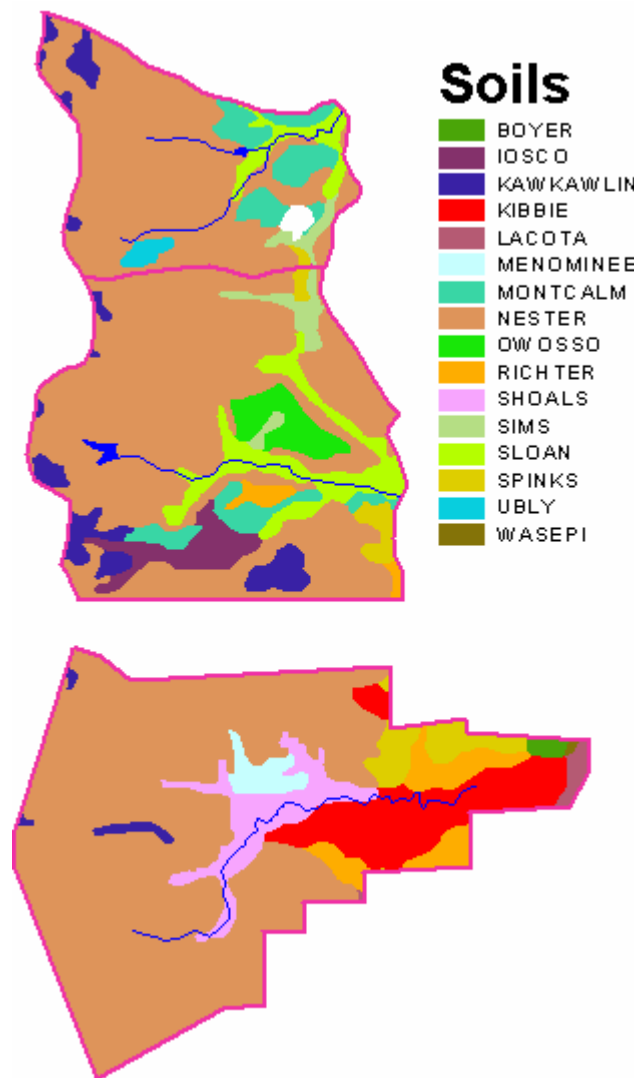


Figure C: Soil Types

Fillmore

A: 12.2%

B: 3.8%

C: 77.5%

D: 6.4%

Bauer

A: 5.8%

B: 10.5%

C: 73.6%

D: 10.2%

Hager

A: 3.7%

B: 14.4%

C: 81.0%

D: 0.9%

Soils

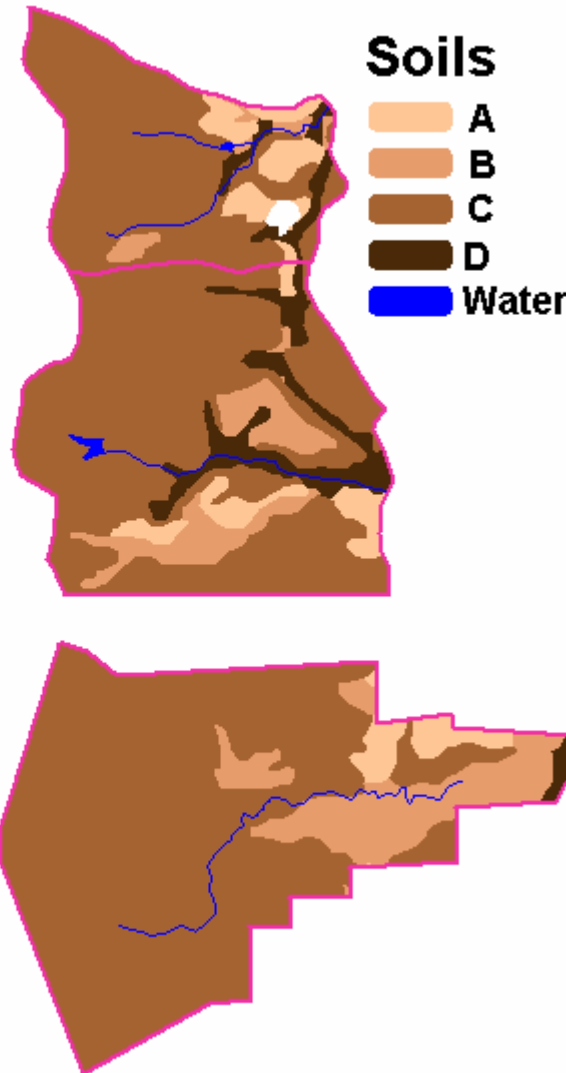


Figure D: Soil Hydrogroups

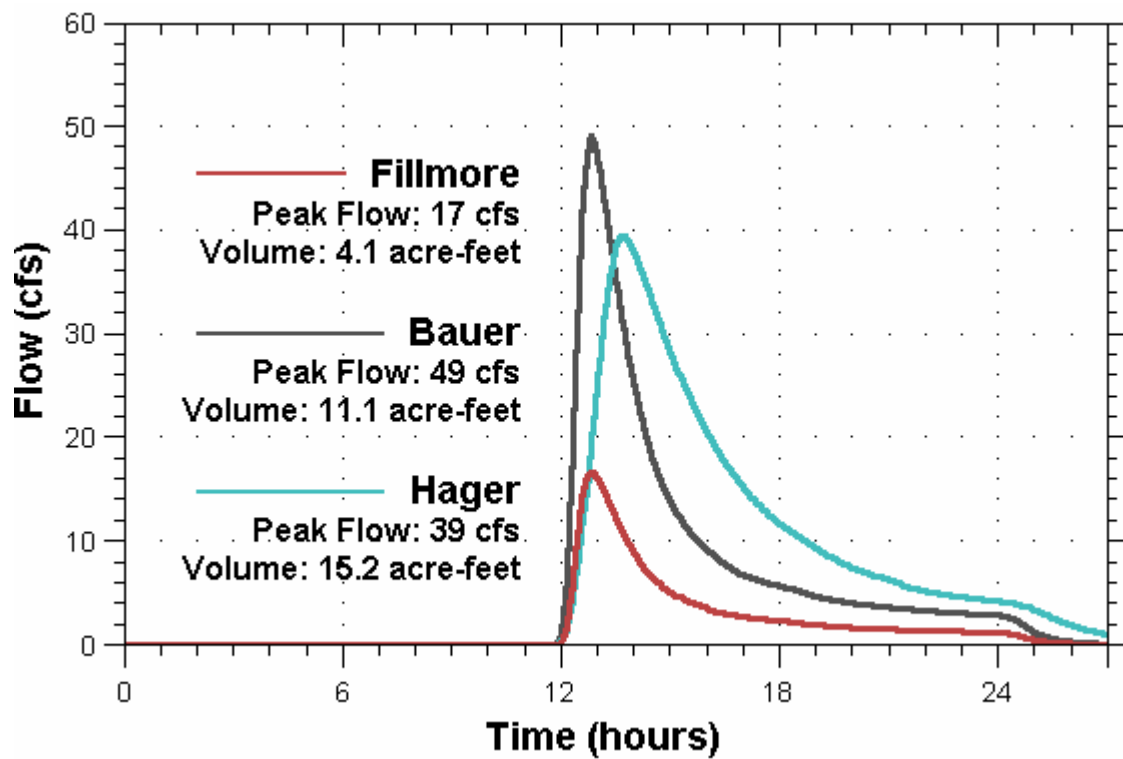


Figure E: 1-Year Storm, Calculated Discharges

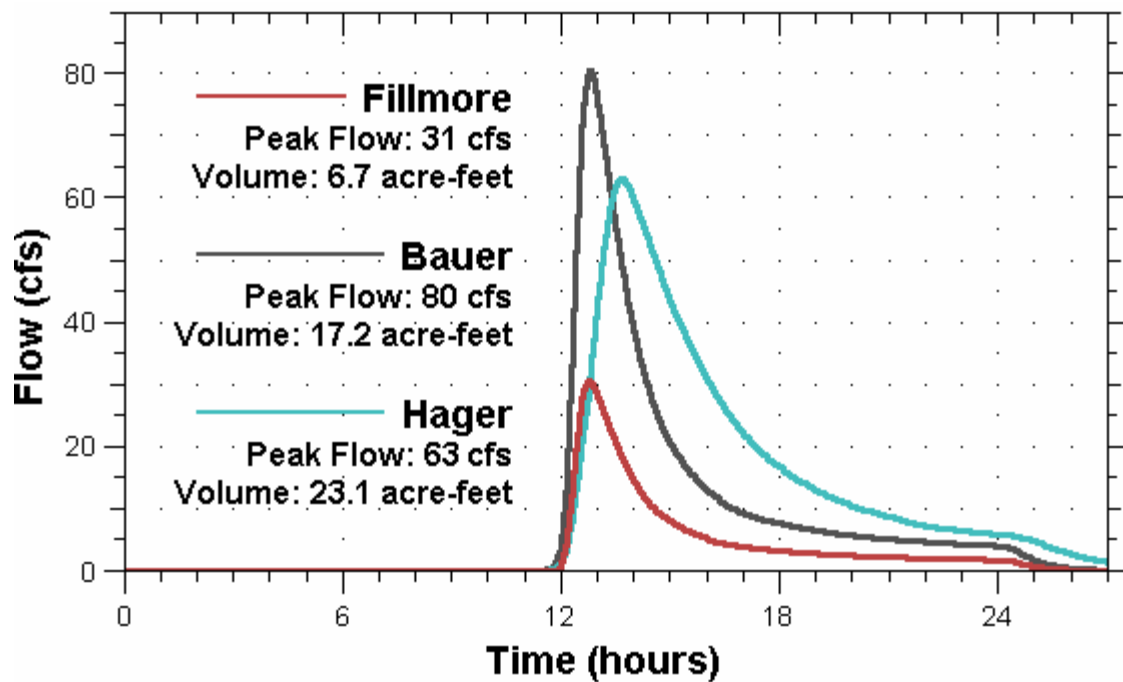


Figure F: 2-Year Storm, Calculated Discharges